

 <p>STANDARD</p> <p>Geo-Registration Local Set</p>	<p>MISB ST 1601</p> <p>27 October 2016</p>
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1 Scope

This standard defines metadata to support the identification of a geo-registration algorithm and various outputs from a geo-registration process. It is intended to be used in conjunction with the KLV construct Amend Local Set as defined in MISB ST 1607 within an existing Local Set that contains the component elements of a sensor model.

2 References

- [1] MISB ST 0601.10 UAS Datalink Local Set, Oct 2016.
- [2] MISB ST 0902.5 Motion Imagery Sensor Minimum Metadata Set, Oct 2015.
- [3] MISB ST 1607 Constructs to Amend/Segment KLV Metadata, 2016.
- [4] MISB MISP-2017.1: Motion Imagery Handbook, Oct 2016.
- [5] MISB ST 0107.2 Bit and Byte Order for Metadata in Motion Imagery Files and Streams, Feb 2014.
- [6] SMPTE ST 336:2007 Data Encoding Protocol Using Key-Length-Value.
- [7] MISB ST 0807.18 MISB KLV Metadata Registry, Oct 2016.
- [8] MISB ST 1303 Multi-Dimensional Array Pack, Feb 2014.
- [9] ITU-T X.667 | ISO/IEC 9834-8 Information technology - Procedures for the operation of object identifier registration authorities: Generation of universally unique identifiers and their use in object identifiers, 14 Oct 2012.
- [10] IETF RFC 4122 A Universally Unique IDentifier (UUID) URN Namespace, Jul 2005.
- [11] NGA.RP.0001_1.0.0 NGA REcommended Practice for Universally Unique Identifiers, Jan 2013.
- [12] ISO/IEC 10646:2014 Information technology – Universal Coded Character Set (UCS).

3 Terms, Acronyms and Definitions

KLV	Key Length Value
LS	Local Set
MDARRAY	Multi-Dimensional Array

SDCC-FLP Standard Deviation and Correlation Coefficient Floating Length Pack

4 Revision History

Revision	Date	Summary of Changes
ST 1601	10/27/2016	<ul style="list-style-type: none"> Initial Release

5 Introduction

Geo-registration, generically defined and as used in this document, is the process of revising sensor model metadata through accuracy transference from external sources. The basic metadata parameters needed for a sensor model are contained in an existing Local Set (e.g. MISB ST 0601 [1] and profiled in MISB ST 0902 [2]). Through the KLV construct of the Amend Local Set defined in MISB ST 1607 [3], the basic sensor model parameter values revised through the geo-registration process are “amended” within the KLV construct. More information regarding this topic can be found in the Motion Imagery Handbook [4].

The Geo-Registration Local Set provides the additional metadata necessary to identify geo-registration algorithms and additional geo-registration process output data not contained in the original Local Set.

6 Geo-Registration Local Set

The Geo-Registration Local Set is a KLV Local Set whose elements provide information specific to a geo-registration algorithm, such as name and version, and additional geo-registration output, such as correspondence points.

6.1 Conventions

Requirement(s)	
ST 1601-01	All metadata shall be expressed in accordance with MISB ST 0107 [5].
ST 1601-02	Formatting of Geo-Registration metadata shall be compliant with SMPTE 336 [6] encoding rules for Universal Labels and Local Sets.

6.2 Geo-Registration Local Set

The Geo-Registration Local Set 16-Byte Universal Label is registered in MISB ST 0807 [7] as:

06.0E.2B.34.02.0B.01.01.0E.01.03.03.01.00.00.00 (CRC 39238)

The Geo-Registration Local Set is summarized in Table 1. The Tag ID column indicates the KLV tag to use when specifying the value in the Geo-Registration Local Set. The Name column links the Tag to the purpose of the value as defined in the Reference column. The Key denotes the KLV dictionary key that is associated with the value. Units specify the units of the value; a value of N/A means Not Applicable. The Type specifies the data type (binary format) used when

encoding the local set into binary. The Rules column indicates if the value is Mandatory or Optional. If the item is Mandatory the value is required within the Local Set. If the item is Optional the item is not required to be included in the set. Note: The Format uint is generalized to allow the application to define the number of bytes needed for a values representation. The length is indicated by the “Length” of the KLV triplet.

Table 1: Geo-Registration Local Set Elements

Local Set Key			Name		
06.0E.2B.34.02.0B.01.01.0E.01.03.03.01.00.00.00 (CRC 39238)			Geo-Registration Local Set		
Constituent Elements					
Tag ID	Name	Key	Units	Type ¹	Rules
1	Document Version	06.0E.2B.34.01.01.01.01.0E.01.02.05.05.00.00.00 (CRC 56368)	N/A	uint	Mandatory
2	Algorithm Name	06.0E.2B.34.01.01.01.01.0E.01.04.03.03.00.00.00 (CRC 48077)	N/A	utf8	Mandatory
3	Algorithm Version	06.0E.2B.34.01.01.01.01.0E.01.04.03.03.00.00.00 (CRC 48077)	N/A	utf8	Mandatory
4	Correspondence Points – Row / Column	06.0E.2B.34.01.01.01.01.0E.01.01.03.41.00.00.00 (CRC 31544)	pixels	MDARRAY	Optional
5	Correspondence Points – Latitude / Longitude	06.0E.2B.34.01.01.01.01.0E.01.01.03.41.01.00.00 (CRC 19464)	degrees	MDARRAY	Optional
6	Reference Image Name	06.0E.2B.34.01.01.01.01.0E.01.04.03.03.00.00.00 (CRC 48077)	N/A	utf8	Optional
7	Algorithm Configuration Identifier	06.0E.2B.34.01.01.01.01.0E.01.04.03.04.00.00.00 (CRC 60128)	N/A	UUID	Optional

¹Note on Lengths: Types with unspecified lengths in the Geo-Registration Local Set are computed by the size of the value. For example, if a uint value is less than 255 then only one byte is needed. See the Motion Imagery Handbook [4] for more information on data types and lengths.

6.3 Geo-Registration Local Set Elements

6.3.1 Document Version

The Document Version identifies the version of ST 1601 used in the implementation.

Requirement	
ST 1601-04	A Geo-Registration Local Set shall include the Document Version metadata element.

6.3.2 Algorithm Name

Algorithm Name uniquely identifies the algorithm used to geo-register the Motion Imagery frame data to produce revised sensor model parameter values.

Requirement	
ST 1601-05	A Geo-Registration Local Set shall include the Algorithm Name metadata element.

6.3.3 Algorithm Version

Algorithm Version is an alphanumeric that uniquely identifies the specific version of the Algorithm Name used to geo-register the Motion Imagery frame data.

Requirement	
ST 1601-06	A Geo-Registration Local Set shall include the Algorithm Version metadata element.

6.3.4 Correspondence Points – Row / Column MDARRAY

The Correspondence Points – Row / Column MDARRAY (Multi-Dimensional Array) is an extensible list of tie points represented in pixel space used by a geo-registration algorithm to align the Motion Imagery frame to a reference image. The array contains the row / column location of the tie point in the Motion Imagery frame and the row / column location of the tie point in the reference image. The array is formatted according to MISB ST 1303 [8] rules, and the parameters for the Multi-Dimensional Array are:

MDARRAY(Note_A, 4, Note_B, Note_B)

Note_A: Array(0, 0, c) = 06.0E.2B.34.01.01.01.01.0E.01.01.03.3F.01.00.00 (CRC 44071)^a

Array(1, 0, c) = 06.0E.2B.34.01.01.01.01.0E.01.01.03.3F.02.00.00 (CRC 62839)^b

Array(2, 0, c) = 06.0E.2B.34.01.01.01.01.0E.01.01.03.3F.01.00.00 (CRC 44071)^c

Array(3, 0, c) = 06.0E.2B.34.01.01.01.01.0E.01.01.03.3F.02.00.00 (CRC 62839)^d

c = all columns

Note_B: This value is dependent upon the number of tie points produced between the Motion Imagery frame and the reference image.

^aThis KLV key represents the row value of the tie point for the Motion Imagery frame.

^bThis KLV key represents the column value of the tie point for the Motion Imagery frame.

^cThis KLV key represents the row value of the tie point for the reference image.

^dThis KLV key represents the column value of the tie point for the reference image.

6.3.5 Correspondence Points – Latitude / Longitude MDARRAY

The Correspondence Points – Latitude / Longitude MDARRAY is an extensible list of tie points represented in ground space used by the geo-registration algorithm to align the Motion Imagery frame to the reference image. The array contains the latitude / longitude of the tie point. The parameters for the Multi-Dimensional Array are:

MDARRAY(Note_A, 2, Note_B, Note_B)

Note_A: Array(0, 0, c) = 06.0E.2B.34.01.01.01.01.0E.01.01.03.28.00.00.00 (CRC 53661)^a

Array(1, 0, c) = 06.0E.2B.34.01.01.01.01.0E.01.01.03.29.00.00.00 (CRC 42793)^b

c = all columns

Note_B: This value is dependent upon the number of tie points produced between the Motion Imagery frame and reference image.

^aThis KLV key represents the latitude value of the tie point.

^bThis KLV key represents the longitude value of the tie point.

6.3.6 Reference Image Name

Reference Image Name uniquely identifies the reference image used to geo-register the Motion Imagery frame.

6.3.7 Algorithm Configuration Identifier

Algorithm Configuration Identifier is a generic identification system based on a Universal Unique Identifier (UUID) to differentiate a particular configuration or set of parameters for a specific Algorithm Name and Algorithm Version. It is up to the algorithm vendor to identify the set of variable configuration parameters and values for each algorithm to form the basis of the UUID.

A UUID can be generated using multiple techniques as discussed in [9] and [10]. NGA Recommended Practice [11] discusses which UUID versions may be used.

This Standard recommends UUIDs be constructed from unique configuration information through UUID Version 4 leveraging random numbers or UUID Version 5 leveraging Secure Hash Algorithm (SHA) coding process. For example, combine minimization thresholds, minimum number of tie points, correlation settings, etc. and use either truly random numbers or the SHA hash function to generate the UUID.

7 Appendix A – Example: Geo-Registration incorporated into MISB ST 0601 – Informative

In this example, a generic sensor model represented by 11 dynamic elements from MISB ST 0601 define the imaging ray. The concept of how to leverage MISB ST 0601 Tag 101: Amend Local Set is illustrated in Figure 1.

ST 1601 Geo-Registration Local Set

Note the MISB ST 0601 Tags 5, 90, 91, 13, 14, 75, 16, 17, 18, 19 & 20 with their values defined in the base ST 0601 local set, are reused within Tag 101. These same 11 tags with possibly new revised values with the addition of Tag 102 reflect the results of a geo-registration process.

Although only 11 metadata elements are indicated here, other MISB ST 0601 tags are permitted within the value portion of the Amend Local Set Tag 101, such as the SDCC-FLP tag as shown. A receiver is free to select tags with their corresponding values from the base set or the substituted set.

Finally, Tag 98 Geo-Registration Local Set (indicated as GEOR LS) is included, with specific attributes of the geo-registration process. By way of extension, multiple results from multiple geo-registration algorithms can be represented within one metadata stream by instantiating one Tag 101 Amend Local Set per geo-registration process.

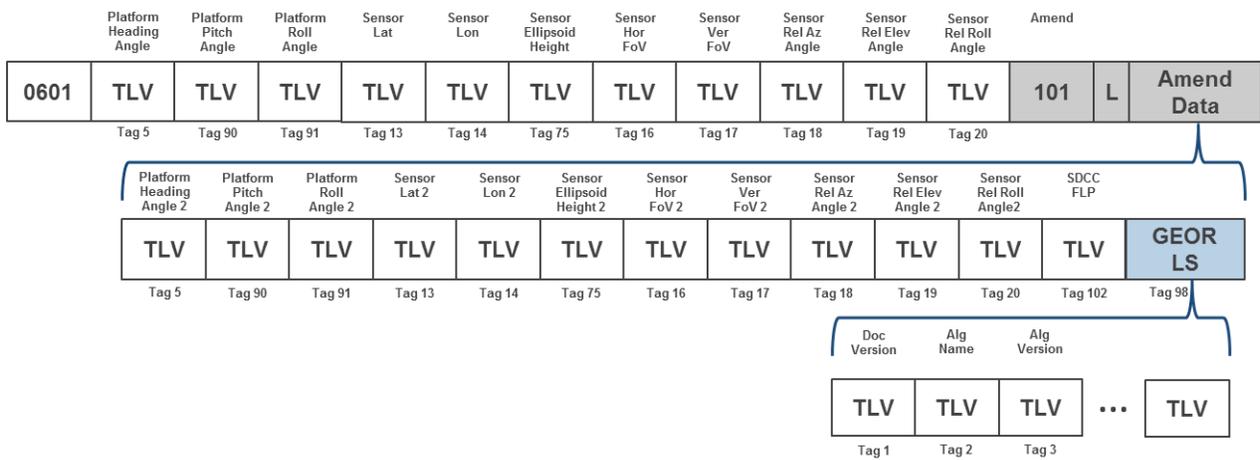


Figure 1: Use of ST 0601 Tag 101 – Amend Local Set to embed a Geo-Registration LS.